

BALANCING

FIRE SUPPRESSION WITH FIRE RISKS

EXECUTIVE LEADERSHIP

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ABSTRACT

This research is the initial step in determining if a quantifiable method of analysis could be utilized in developing an appropriate balance between fire suppression abilities and the fire risks and hazards within a community. The values or elements that should be considered in the analysis and the amount of effort that such an assessment could entail were explored.

This research effort utilized both historical and action research to (1) determine if a quantifiable method of analysis could be utilized to develop an appropriate balance of fire suppression abilities and the fire risks and hazards within a community, (2) to determine what elements or values and specific components must be examined to develop a quantifiable method of analyzing such a balance, and (3) determine the amount of effort on the part of a fire agency that would be required to make a quantifiable analysis effective.

The historical research procedure assessed sources that could provide the basis upon which to determine the validity of the basic analysis premise. The same resources contributed a number of viable elements which could be utilized for the analysis process. Those elements were consolidated into a final list of eleven analysis elements. An appendix was utilized to assemble the definition and support specifics of the analysis elements.

The research concluded that an analysis could be made which would provide a method to determine what is required to balance the fire suppression abilities of a fire department with the fire risks and hazards within a community or region. The study also provided adequate information to determine that such an analysis would have a sizable workload impact. Most importantly, the research provided a list of elements which could be appropriately utilized as a guide in making the analysis.

The recommendations from this research determined that though the usage of the entire analysis process certainly had significant value, the ability to utilize the elements of the analysis to guide day-to-day response decision processes and more importantly long range planning of fire suppression response efforts. Immediate elements which the elements could be utilized is in the measuring of the effectiveness and efficiency of present operations. Other usages of the elements could be in areas of data gathering or collection, considerations of manpower levels, and others.

Regardless of the level of utilization, the movement of any organization toward a balance between fire suppression response abilities and the fire risks or hazards within a community is of significant value and a strong step toward providing the appropriate level of service for the community or area served.

TABLE OF CONTENTS

	Page
Abstract	2
Table of Contents	4
Introduction	5
Background and Significance	6
Literature Review	10
Procedures	19
Results	20
Discussion	23
Recommendations	25
Reference List	26
Appendix A (Elements of Analysis)	28

INTRODUCTION

The Brighton Fire Protection District, along with many other fire agencies located along the front range of Colorado, is experiencing a phenomenal growth rate. The present growth pace in the community of Brighton alone is setting state wide records. This phenomenal growth continues to drive increased demands for fire department services.

In addition, the Brighton Fire Protection District continues to experience the national taxpayer, watchful eye, sentiment. State and local taxpayers continue to scrutinize the costs of governmental services, rightfully wanting to maximize value at minimum costs. Though tax mill levy increases have become somewhat more readily accepted by Colorado taxpayers, there are no certainties.

Fire suppression continues to be a primary service provided by the Brighton Fire Protection District, along with most fire agencies, and yet it is becoming the service least continuously utilized or even recognized by the public. To maintain continued public support of this vital service, fire agencies must demonstrate the highest quality and value in suppression services. The Brighton Fire Protection District and other fire agencies must develop appropriate means of matching the agency's service capabilities with the demands presented by the fire risks and hazards of the areas served. A balancing methodology must be developed to determine a consistency or equivalency between the fire risks and hazards in the community and the service capability of the fire agency.

The purpose of this research was to assess the extent and depth of analysis necessary to develop such a balancing methodology, the elements or values of a fire agency which must be considered in the methodology, what specifics should be considered in these elements, and finally the amount of effort required to perform such an analysis. Utilizing this research as the

foundation, the final goal is to actually develop such an analysis tool and balancing methodology.

Utilizing historical and action research methods, the solutions to the following questions were sought.

1. Could a quantifiable method of analysis be utilized to develop an appropriate balance of fire suppression abilities and the fire risks and hazards within a community?
2. What elements or values and specific components must be examined to develop a quantifiable method of analyzing such a balance?
3. What amount of effort on the part of a fire agency would be required to make a quantifiable analysis effective?

BACKGROUND AND SIGNIFICANCE

The Brighton Fire Protection District is located on the northern boundaries of the Denver, Colorado Metropolitan area and encircles the new Denver International Airport on three sides. The Denver Metro. region and many other areas along the front range of Colorado are experiencing a tremendous growth rate. In a recent local newspaper, the Standard Blade (July 3, 1999, p. 1), the growth rate for the community of Brighton alone is being projected at an annual pace of ten percent. Within the Brighton region, demographic development is greatest in areas of single and multi-family housing but more recently, a surge in consumer service and retail sales, light industry, and even high rise office type occupancy construction has begun.

In 1994, the taxpayers of Colorado passed an amendment to the State Constitution that created a local and state government - tax revenue income and spending limitation. This new law has limited most government agencies to less than eight percent annual increases in revenue and

spending abilities. In the case of the Brighton Fire District, most of the recent annual revenue and spending limitations for the District have been in the five percent range; well below the growth rate experienced.

Growing demands for service are experienced months before the limited tax rate increases, provided only by increased assessed valuations, reach the revenues of the Fire District. As well, the natural growth in service demands due to community age and change, all make increase demands on service provisions without economic support. This imbalance is not new, in fact in his 1979 contribution to the ICMA's *Managing Fire Services*, Mr. Harry Hickey pointed out that,

“The growing opposition to increased spending for public service delivery systems is of deep concern to local officials. Fire chiefs in particular find themselves in a paradoxical situation. The fire service is under pressure to upgrade the level of service while at the same time the fire chief is told to hold the line on taxes needed to pay for improved or expanded services (p. 41).”

Hickey continues by pointing out,

“A fundamental question then emerges: How can the fire protection delivery system meet the standards of efficiency and effectiveness demanded by service conscious, fiscally aware citizens (p. 41)?”

A new service and revenue problem has surfaced recently for the Brighton District. For years, the neighboring fire district to the south of the Brighton District has provided fire services primarily for an area occupied by a city other than Brighton. Within the past five years, that same city has begun annexing large areas within the Brighton Fire District. Utilizing an Intergovernmental Agreement approach, the city and the adjacent fire district have established limited unification; more recently announcing that where the city goes, so does the other fire district. This attempt at taking tax revenue base and area base from the Brighton Fire District

could create significant problems for the District. The territory loss will cause a large loss of existing revenue and an even more significantly, large amounts of future revenue. The change could create the loss of effectiveness of one of the Brighton District fire stations. This type problem is not new to the fire service but it is certainly new and very significant to the Brighton District.

Should territory disputes between two Special District levels of government reach a court dispute, Colorado State Statute requires the district attempting to take over the territory to prove that it can provide a superior service capability. A process which will require each district to provide adequate definition and service capability substantiation to the courts for a final decision.

The rapid local growth, combined with the State's taxpayer referendum on tax increases, and now the recent boundary conflict, forces the Brighton Fire Protection District to face many self analysis and planning decisions which could have significant impact on the future of the District - mostly centered around one central theme: how to provide the most effective fire suppression services at the least revenue burden while simultaneously providing a service capability defense for a potentially significant court battle.

Former California Fire Marshal Ron Coleman, at a recent International Association of Fire Chiefs sponsored seminar on Fire Department Accreditation in Las Vegas, Nevada (May, 1999), pointed out in his class handout that some of these issues exist throughout the fire service and sums up the dilemma with his statement:

“There is no lexicon for the fire service for comparing risks, hazards and values in preparation for discussing the various levels of protection and the rationale for standards for response coverage. Many departments can produce maps, pre-fire plans and fire prevention and incident records, but few can provide a systematic framework for

typography of the problem. As a result, they often have some difficulty evaluating the appropriateness of the actions or the level of effort being taken to control the fire problem (p. 2).”

Mr. Coleman, follows in his handout, with this possible direction to a solution to these long standing fire service problems.

“The creation of such a taxonomy (ability to make projections for setting public policy on the appropriate level of effort and service to provide for a community) ... provides the methodology to compare a communities level of effort against a comparable level of risk (p. 3).”

In conclusion to his thoughts about balancing fire suppression with the fire demands of the community, Mr. Hickey (1979) indicates that;

“The final plan should reflect a quality of community or regional fire safety based on both professional and citizen expectations; it should clearly define the level of risk the community or region is willing to bear; it should clearly document the costs associated with the planned level of service; and it should plot a future course of action to either achieve or maintain prescribed levels of community or regional safety over at least a ten year period. Above all, the master planning process should identify both the capability and the limitations of the public fire service delivery system (p. 65).”

Within the “Executive Leadership” course of the Executive Fire Officer Program, a significant amount of the discussion relates to long range planning, as well as planning and leading organizations through significant change and development. This research effort is intended to provide the basic elements necessary for the assessment of the fire suppression capabilities of the

Brighton Fire District and identify potential changes in those capabilities that might be necessary to be successful in dealing with the problems outlined in the Background and Significance discussion.

LITERATURE REVIEW

Quantifiable Appraisal Methodology

Throughout the history of the American Fire Service, the question of fire response capability and adequacy as compared to the fire risks and hazards that are within the community or response region has been asked and answered in a multitude of ways. Most often, the criteria considered was based on response times, pumping capacities, water supplies, manpower to handle the likely needed hoselines, historical information related to the types and numbers of alarms for fires and the Insurance Services Office's *Commercial Fire Rating Schedule* requirements for response distances, company types, and quantities.

In the more recent history of the fire service, a number of very specific studies have been completed dealing with this capability/adequacy question or specific components of the question. These more recent studies tend to approach the problem from a larger perspective and attempt to deal with the many inter-reactions presented by the many elements which now are recognized (as determined from the studies) as a important value consideration. This momentum toward a more system wide approach to solving this and related questions has been driven by the very reasons noted in the Background and Significance. Ron Coleman, in his Las Vegas presentation handout (1999), noted that:

“The level of effort and level of service provided to mitigate a fire problem, if it is based solely on fire statistics, is a catastrophe waiting to happen. The fire service profession has a greater need to be able to analyze fire conditions than any other agency in the

community (p. 3).”

In the late 1970's, the Rand Institute developed models for fire company allocations and fire station locations for the City of New York. These models dealt with the number and size of fire companies on duty, and the number, types, and locations of companies in an area. As well, the study considered the number and types of companies that should be sent on specific alarm types (Walker, 1979, p. 73, 74). The ultimate goal of the study was to achieve a more economic structure for fire protection. At the time, this study was perhaps the most systematic approach to overall fire service considerations.

In 1977 the Research Triangle Institute published the *Municipal Fire Service Workbook*. The effort was designed to study and assist with the analysis of fire service performance and service delivery. This study focused on measurement of an organization's productivity, a means of comparing abilities of similar communities, and a means of analyzing other fire loss statistics as a service measurement comparative ability (Bryan & Greene, 1979, p. 119, 369, 371, 377).

The late 1970's also brought about a computer aided ability to determine fire station locations using a software developed by Public Technology, Inc. This technology provided a means to more accurately analyze the impact on apparatus travel time - of traffic situations like intersections, different street types, and multitude of trip starting and ending locations; all simultaneously (Coughlin and Penner, 1991, p. 29). The focus of this effort was to simplify improvements in response times as a primary value of the local fire service response capability.

Hypothesizing that the level of manpower at a fire incident is an important value of a fire

departments service capabilities, the Dallas Texas Fire Department (1983 - 1984) undertook a very detailed study to determine operational efficiencies of fire companies at different working fire scenarios. Specifically, the actual fire ground tests were developed to determine the efficiency of different staffing and those impacts on the operations at fires (O'Hagan, 1984, p. 16).

In addition to the several studies that have been completed dealing with the dilemma of fire service response adequacy, many fire service related agencies have taken a serious look at this problem and have created several documents which relate specifically to the problem. These agencies appear to have utilized information to that was concluded in the previously noted studies but have expanded those conclusions to accomplish an even wider perspective of the fire response.

More recently, the International Association of Fire Chiefs (IAFC), through its *National Fire Service Accreditation Program* and specifically with the program's *Fire and Emergency Service Self Assessment Manual*, has developed a fairly large list of items which should be considered when making decisions about the adequacy of fire alarm response. The list includes many of the items covered in previously mentioned studies with some additions. The items listed are again considered from a more systematic approach and are summarized by:

..."based upon several variables, all of which interact to create a service level in the community ... includes, deployment of resources, identifying risks and expectations, looking at distribution and concentration of resources, time parameters, reliability of resources and actual performance (IAFC, 1995, sec. 6-2)."

The National Fire Protection Association (NFPA) published a proposed standard, NFPA 1200 - *Standard for Organization, Operation, Deployment, and Evaluation of Public Fire*

Protection and Emergency Medical Services, 1998 Edition, the draft indicates that the evaluation of fire protection services should consider a community's fire risks, the community's experience with fire and the local fire problem. The NFPA publication suggests consideration of changes that may be occurring within the community including items of population growth, new construction and other changes in the demographics of the community as possible service ability impacts (p.6)."

Another agency, somewhat related to the fire service, that has made a continual impact on the consideration of fire alarm response adequacy is the Insurance Services Office (ISO). The ISO produced the "Grading Schedule for Municipal Fire Protection" that provides a tool for the insurance industry to utilize as a relative comparison between a communities existing conditions with a relative criteria for multiple components of the local fire protection system. The comparisons are based on four primary components: water supply, fire department, fire service communications, and fire safety control. Based on these components and the local protection system's performance within them, a protection class rating is assigned for the fire department. This class rating is used by insurance companies to compare a local municipal fire service with other services. The "Grading Schedule" continues to be a large factor in determining response levels and "adequacies" by fire service personnel in many communities.

The fire department component of the ISO Schedule, considers four items: equipment and apparatus, personnel, and the quality and completeness of the training and operations of the fire department. The evaluation process within the fire department area can be summarized by - the greater the fire suppression water flow requirements demanded by the community's risks and hazards, the greater the need for equipment, apparatus, and personnel located more closely to the risks and hazards.

Independent authors studied have identified a few additional elements that potentially should be considered in assessing a fire department's service adequacy. Some elements provided the sources are expansions of the lists created by the formal studies and fire service related agencies. Though the authors may not have considered the elements in a perspective of the entire fire service organizational system, the elements identified are worthy of significant consideration.

John Granito, in a revision contribution to a chapter of the *Fire Protection Handbook* (1997), indicated that:

“In evaluating the adequacy of fire protection in any given area, major consideration must be given to the ability of the fire department to handle efficiently any reasonable anticipated work load. This requires an evaluation of the possibility of simultaneous working fires and other emergencies; weather factors that may contribute to the spread of fire, the delay in response, or the possibility of slow operations at the scene; and other demographic or geographic conditions that might affect the frequency, severity, and spread of fire occurrence and the response time of initial fire fighting units (p.10-34).”

Mr. Harry Carter, in a 1997 article for *Firehouse Magazine*, defined two primary elements necessary for a progressive effort in planning for a community fire response plan. The first element noted by Carter is the development of an understanding of the fire protection problems, previous protection performance, and existing fire defense mechanism operations within the community. “Gathering and analyzing historical information is a critically important tool for studying the future (p. 118).” The second element indicated by Carter as critical is analysis of the fire risks and hazards within the community and the impact of those risks and hazards on the abilities of the fire protection system.

“Risk analysis must be done to determine the fire department’s operational status as it relates to community needs (p. 119).”

Ron Coleman, again in his Las Vegas seminar handout (1999), has also looked at the need for a community to consider the importance of what fire risks are within the area and its commitment to deal with those risks. “It is totally impractical to seek a zero-tolerance level for risk. It is neither economically or socially sound (p. 13).” Coleman indicates that the determination of how significant a community’s fire risk tolerance is a consideration of how it will support the fire protection service within the community. “Therefore, an acceptable risk is an expression of just how high a level of risk the community allows to exist and is also willing to protect (p. 14).”

Based on the information discovered in the Literature Review, it seems obvious that many fire service professionals, fire service related organizations, and study groups have extended considerable consideration of the concept of a qualitative approach to balancing a fire department’s fire alarm emergency response to the needs of a community and more specifically to the fire risks and hazards within the community.

Elements of a Quantifiable Appraisal Methodology

The specific elements of an appraisal methodology, identified in the study completed by the Rand Institute, are broken into long term considerations and short term considerations. The term of consideration relates to growth and development considerations within the department or as related to the day to day efforts.

* The long term elements were listed in the study as:

- “- How many fire companies should be on duty?
- How many fire companies should be allocated to each region for the jurisdiction?
- Where should the jurisdiction's fire companies be located?
- How many fire fighters should be assigned to each fire company (Walker, 1979, p. 73)?”
- * The short term elements were listed in the study as:
- “- How many fire companies of each type should be sent to an incoming alarms?
- Which particular fire company should be dispatched (Walker, 1979, p. 74)?”

In summary, these elements most closely deal with resources and deployment of those resources.

As previously noted, the Research Triangle Institute study determined that the primary elements necessary in an analysis of a fire department's services were measurements of its productivity, a model to compare the department with others in similar communities and other means of comparing fire loss statistics in similar communities as well. The specifics of measuring productivity is related to inputs, effectiveness, and total operational costs to the community (Greene, 1979, p. 369, 371, 377).

Concentrating on the travel time portion of emergency response times, the Public Technology, Inc., sought to integrate many travel time impact variables into a computer based means of looking at and determining improved fire station locations to achieve the lowest practical time frame. Because the travel time may be the largest element of the response time factor, focusing on that time period and achieving the greatest improvement possible in that time frame would potentially provide the most overall improvement in response times (Coughlin and Penner, 1991, p. 29, Barr and Caputo, 1997, p. 10-251).

The most complete study in manpower efficiency level studies was found in the Dallas Fire Department effort. The important aspect of this study was to look at multiple types of fires from a staged scenario within a somewhat controlled operational evolution basis. The efficiencies of the different levels manpower for each scenario evolution which could be utilized in determination in the size of responding companies in specific types fire risk areas, the number of companies which should respond, and the types of companies needed in the response was the ultimate goal (O'Hagan, 1984, p. 16).

In the 1995 publication of the IAFC's *Fire and Emergency Service Self Assessment Manual*, a fairly sizable list of elements for measuring a fire department's capability is provided in

Appendix A. The elements are:

- “- Distribution of resources throughout the area served
- Initial Attack Capability relative to the types of risks within the primary response area
- Effectiveness as a measure of performance
- Concentration as related to the assembly of the overall resource needs for a fire risk
- Multiple alarm capability, again assembly of additional resources should the need develop
- Efficiency in relationship to the overall cost measure
- Response Reliability, assuring that the necessary resources will be available when needed
- Drawdown limitations when requests for mutual aid arise
- Resource Exhaustion as the limit of resources available in an area/sub-area for response

- Historical Response Data as a means of comparison of changes and improvements (p. 6-26 through 6-30).”

The proposed standard, NFPA 1200 - *Standard for Organization, Deployment, and Evaluation of Public Fire Protection and Emergency Medical Services* (1998), specifically Section 3-2 “Community Fire Protection Evaluation”, lists the following elements which should be considered in the evaluation of fire protection services.

- “- nature, extent, and magnitude of fire risk within the community
- community’s actual experience with fire, including trends indicated by the experience data
- changes that are occurring or are anticipated in the population and the built environment
- existing fire suppression capabilities of the fire department
- costs and effectiveness of changes to the fire suppression capabilities of the fire department
- the actual, estimated or projected cost of each component of public fire department
- alternative and acceptable levels of risk (p. 6)”

The elements contributed by each of the independent authors are accumulated in the following list:

- ability of the fire department to handle efficiently any reasonable anticipated work load with consideration of weather factors and impacts (Granito, 1997, p. 10-34)
- development of an understanding of the fire protection problem, previous protection

performance, and existing defensive mechanisms within the community through historical information analysis (Carter, 1997, p. 118)

- analysis of fire risks and hazards within the community (Carter, 1997, p. 119)
- determination of the acceptable level of risk within the community (Coleman, 1999, p. 14)

As can be seen from an analysis of the elements derived from the literature reviewed, there are several elements which are duplicates or extremely similar in nature. To compile a single consolidated list of elements for a balancing appraisal methodology requires a detailed review of the specifics that were utilized in the creation of the particular element. To provide a more useful list of elements, descriptions of those specifics are necessary as well. Those descriptions are provided through an expanded literature review in Appendix A.

PROCEDURES

Definition of Terms

Acceptable Level of Risk. “An acceptable level of risk is an expression of just how high a level of [fire] risk the community to exist” (Coleman, 1999, p. 14).”

Quantifiable. “To define, document, display, develop alternatives and recommend solutions to the communities fire problem to the policy makers (Coleman, 1999, p. 1).” In this research, quantifiable is specifically dealing with a communities fire suppression abilities.

Staffing Levels (manpower levels). “Consists of the number of personnel and their task assignments (IAFC, 1995, p. 6-5).”

Research Methodology

The purpose of this research effort was to evaluate the viability of a quantifiable method to determine if a comparative balance between fire suppression abilities and the fire risks exist or could exist within a community, the elements or values which must be considered in such a analysis, and the impact that analysis might have on the workload of a fire department. The research was historical in nature due to the literature review that was conducted to determine the present information available on the subject and related subjects.

The research is action oriented because the answers to the research questions can and will be utilized by the Brighton Fire Protection District to determine its fire suppression abilities in comparison to the fire risks that exist within the District. The elements necessary to accomplish such a balance determination, derived from the historical research, will all be utilized in the quantifiable determination of existing balance or imbalance within the District; providing the basis upon which potentially necessary alterations may be determined. Those alterations can then be presented to the public policy officials of the District for assessment and hopefully revision.

Assumptions and Limitations

It was determined from the research effort that no sources of information could be located that considered the amount of effort necessary to complete a fire suppression ability and fire risk balance assessment . To achieve the answer to the third research question, only the apparent quantity of work necessary to complete the assessment can be considered and an exact conclusions to the question cannot be supported by multi-source research.

To define and describe the elements needed in a fire suppression/fire risk balance assessment

within a fire department required additional research not covered within the literature review. This research information was consolidated and included in Appendix A for the improved usage of the elements of an assessment.

To complete the comparative balance assessment of fire suppression capabilities with the fire risks within a community, it is assumed by the literature reviewed that the assessment and magnitude determination of the fire risks within a community or region can be completed. As determined in a Executive Fire Officer, Research Project in 1998, by Robert Parker, to complete that assessment can be a sizable task in itself (p. 26). But as noted by most of the literature reviewed, the assessment of the fire risks and hazards within a community or region is an absolute requirement.

RESULTS

Research Question Answers

Research Question 1. Could a quantifiable method of analysis be utilized to develop an appropriate balance of fire suppression abilities and the fire risks and hazards within a community?

From the perspective of the workload impact on the Brighton Fire District and most other fire departments of similar size, and based on the amount of effort required for the analysis process as derived from the research information, the answer to this particular question would likely be - no.

Because the question is seeking more of a value perspective and whether the task could be achieved by such an analytical process, the concluding answer to the question must be - yes. From the information determined in the research, the elements necessary to provide adequate quantifiable measurements are known and those can be compared to the fire risks and hazards within community and region. From that comparison the balancing of the fire suppression abilities to the demands presented by the fire risks and hazards in the community or region came be either assured or

adjusted to reach the appropriate level of balance.

Research Question 2. What elements or values and specific components must be examined to develop a quantifiable method of analyzing such a balance? The research revealed a large number of elements proposed by many sources. It was determined that in most cases, the elements proposed were quite similar or even the same. Some independent authors contributed mostly singular elements that were found to be different from the lists produced by the larger more system wide studies or efforts. From the research and an attempt to compile a collection of the elements which should be considered, the following analysis consideration list was compiled:

- Distribution, the provision of adequate service within a specific boundary limited area
- Initial Attack Capability, the ability to quickly position the required resources to establish an effective first attack at the fire
- Concentration, the ability to increase the response effort to meet the fire attack demands beyond the initial attack within a timely period
- Effectiveness, a system wide measure of the performance or productivity of the fire suppression services provided
- Efficiency, a system wide measure of the ability to provide the desired results at a acceptable cost
- Response Reliability, a measure of the likelihood that the appropriate response resource will be available to respond to a fire alarm
- Drawdown, a limit to the amount of resources that will be allowed to leave the primary

area of response to aid other response areas or agencies

- Resource Exhaustion, the absolute limit of resources available to respond for both initial response and area-wide response
- Historical Response Data, a means of comparing the affectivity and efficiency of the fire service provider with previous performance of itself or other comparable communities or agencies
- Acceptable Level of Risk, the level of fire risk that a community is willing to accept
- Demographic, Geographic, or Environmental Conditions, local conditions pertaining to the specific community that will impact fire suppression responses

This list of elements to be considered, presents a very describable, definable, and quantifiable means of seeking a true understanding of the abilities of a fire suppression force. By utilizing these elements, a fire department should be able to compare their abilities with the demands and impacts posed by fire risks and hazards within their respective community or response area.

Research of each of the individual elements, which is necessary to be able to more capably utilize each element in a fire suppression response perspective, generated a significant number of specific components of each element. The quantity of those specific components expands the definition and detail of consideration necessary in the over analysis process. These specific components are covered in Appendix A.

Research Question 3. What amount of effort, on the part of the fire agency, would be required to make a quantifiable analysis effective? Research efforts produced no sources that could be utilized to answer this question specifically. From the list of elements determined by the research and the analysis required by each element, it can be easily determined that this process

cannot be concluded simply and in a short amount of time. The workload presented by the analysis effort would require either a large resource commitment or the commitment of a large number of hours by a limited resource pool.

DISCUSSION

Because the first research question was begun with the word “could”, the answer to the question became - yes. The literature identified in the research indicates that such an analysis of fire suppression response can be accomplished and the balancing of those response efforts with the fire risks within a community achieved. Through a comprehensive and lengthy analysis, utilizing the elements described in the results of research question two, it is believed that the tasks could be accomplished. To be able to have something to compare the conclusions of the analysis to also requires a lengthy and detailed analysis of the fire risks and hazards of the response area.

The value significance of performing this analysis within the Brighton Fire Protection District is without question. The assessment of fire risks and hazards created by the 1200+ commercial and industrial occupancies and the 10,000+ residential occupancies within the District and comparing those risks with the existing response capability would provide a tremendous basis upon which to begin the changes necessary for possible District improvement for the present and the fast growing future. As previously noted however, the magnitude of the task to achieve this effort is significant and would take either an increase in resources or the expense of a sizable number of man-hours to accomplish; an effort well worth the investment.

Perhaps the greatest limitation that could exist with a “manual” analysis process is the inability to analyze each element derived from the research individually and yet simultaneously as

is required when looking at the response ability as an entire system. The magnitude of the impact of a simultaneous system wide analysis process is obviously unknown but it is certain that approach would create an impact. In the process of looking at the entire system, other elements could evolve or the quantity shortened through consolidation. The development of computer software that would handle such a systems approach would certainly have significant value in this analysis effort.

The commitment to such an analysis may have a sizable impact on the workload of a fire department and the lack of a true system wide simultaneous analysis may not be presently available, may cause fire departments to delay or be truly unable to achieve such an analysis. Just having the elements or components of such an effort will allow fire departments to consider this analysis approach basis in their master or strategic planning efforts. Just including these elements in attempts to look at the response requirements of the future should allow the agency to have a better picture of what that future will be requiring and allow accomplishment of those requirements within a community's expectations and economical boundaries. As John Granito (1997) indicated, "the question of "adequacy" is addressed not only in day-to-day needs, but in major contingencies that can be anticipated for future needs as well. A definition of "optimal" protection is needed - in contrast to "minimal" protection, which fails to meet contingencies and future needs, and "maximal" protection, which is usually more expensive than a community can afford (p. 10-40)."

RECOMMENDATIONS

The ability to utilize the outcome of this research at its intended level of value is obviously the paramount goal, but to utilize the outcome at an awareness level in long range planning and in

day-to-day response decision making efforts is of significant value as well. Perhaps the most immediate usage of the benefits of this research is in consideration of a means to measure response effectiveness and efficiency of present operations. The ability to use the information in updating or creating a strategic plan for budgetary purposes is also highly possible. Gathering of the information necessary to apply the overall analysis process without actually making the analysis will provide data that is likely beyond what is now being accumulated. Gathering the data and information appropriate to each element of the analysis would likely take a large amount of time in itself. Once on an ongoing cycle of collection is achieved, usage of the data in an analysis not only once but as an ongoing process would be more simplified.

Regardless of whether the entire analysis is completed, or only a part of the elements are considered in the department's planning processes, some organization value can be derived from that effort. Working toward a balance between fire suppression capabilities and the fire risks that a community might possess is, at any level of effort, a strong step toward providing quality services and at an economical cost to the taxpayer.

In the case of the Brighton Fire District and its potential boundary confrontation, any attempt to achieve the balance may be more than the neighboring district's efforts, providing a viable defense needed to maintain the current boundary lines. The Brighton Fire District must move ahead on a balancing analysis effort.

REFERENCE LIST

- Barr, Robert C., & Caputo, Anthony P. (1997). Planning Fire Station Locations. In A.E. Cote & J. L. Linville (Eds.), *Fire Protection Handbook* (18th Ed.) (pp. 10-250 - 11-1). Quincy, Ma: National Fire Protection Association.
- Bryan, John L. (1979). Other Organizations and The Fire Service. In John L Bryan & Picard, Raymond C. (Eds.), *Managing Fire Services*. (p. 119). Washington D.C.: International City Management Association.
- Burt, Greg (1999, June). Residential Growth to Come a Halt. *The Brighton Standard Blade*, (p. 1).
- Carter, Harry R. (1996, Sept.). Factors in Fire Risk Analysis For Your Community. *Firehouse*, 72.
- Carter, Harry R. (1997, June). Community Fire Defense Plan: Analyze Before You Organize. *Firehouse*, 118 & 119.
- Coleman, Ronny J. (1999, May). *Risk, Hazard, and Value Evaluation*. Seminar Handout. Las Vegas, Nevada, 1, 2, 3, 13, 14.
- Coughlin, Patrick, Penner, Michael, & Schadowsky, Sharon (1991). *Station Location Analysis, Olathe Fire Department*. Olathe, Kansas. (p. 9).
- Fire Service Organization and Deployment Committee, (1998). *Standard for Organization, Operation, Deployment, and Evaluation of Public Fire Protection and Emergency Medical Services; NFPA 1200*. (p. 6, 10). Quincy, Ma.: National Fire Protection Association.
- Granito, John, (1997). Evaluating and Planning of Public Fire Protection. In A.E. Cote & J.L. Linville (Eds.). *Fire Protection Handbook* (18th Ed.). (pp. 10-33 - 10-40). Quincy, Ma.: National Fire Protection Association.
- Greene, Michael A., (1979). Measuring and Evaluating Productivity. In Bryan, John L. & Picard, Raymond C. (Eds.). *Managing Fire Services*. (pp. 360, 366, 367, 369, 371, 382). Washington D.C.: International City Management Association.
- Harvey, Clifford, S. (1997). Fire Department Information Systems. In A.E. Cote & J.L. Linville (Eds.). *Fire Protection Handbook* (18th Ed.). (pp. 10-45). Quincy, Ma.: National Fire Protection Association.

- Hickey, Harry E. (1979). Evolution of the Fire Service. In Bryan, John L. & Picard, Raymond C. (Eds.), *Managing Fire Services*. (pp. 36). Washington D.C.: International City Management Association.
- International Association of Fire Chiefs (1995). *Fire and Emergency Service Self Assessment Manual*. (pp. 6-2, 6-5, 6-26 - 6-30). Fairfax, Va.: International Association of Fire Chiefs.
- International Fire Service Training Association, (1985). *Chief Officer*. (p. 58). Stillwater, Ok.: Fire Protection Publications, Oklahoma State University.
- Jennings, Charles R. (1999, Feb.). Socioeconomic Characteristic and Their Relationship to Fire Incident: A Review of the Literature. *Fire Technology*, 11 - 13, 27.
- O'Hagan, John T. (1984, Nov.). Staffing Levels: A Major Study. *Fire Command*, 16.
- Paulsgrove, Robin, (1997). Fire Department Administration, and Operations. In A.E. Cote & J.L. Linville (Eds.). *Fire Protection Handbook* (18th Ed.) (pp. 10-21, 10-33, 10-34). Quincy Ma.: National Fire Protection Association.
- Parker, Robert, (1998). *Fire Risk Evaluation Process*. Unpublished Research Project, Executive Fire Officer Program. National Fire Academy, Emmitsburg, Maryland.
- Reaume, Paul A. (1998, June). *Fire Services In Sterling, Colorado*. (pp. 12, 13). The Par Group, Public Management Consultants. Lake Bluff, Illinois.
- Schaenman, Philip S. (1979). Data Collection, Processing, and Analysis. In Bryan, John L. & Picard, Raymond C. (Eds.). *Managing Fire Services* (pp. 455). Washington D.C.: International City Management Association.
- Steen, John E. (1979). Management and Planning For Fire Protection. In Bryan, John L. & Picard, Raymond C. (Eds.). *Managing Fire Services* (pp. 149). Washington D.C.: International City Management Association.
- U.S. Fire Administration (1995). *Fire Data Analysis Handbook*. Federal Emergency Management Agency, p. 141. Emmitsburg, Md.
- Walker, Warren E. (1979). An Introduction to Deployment Analysis. *Fire Department Deployment Analysis: A Public Rand Fire Project*, (pp. 73, 74). New York, N.Y.: Elsevier Science.
- Waters, John R. (1999, Feb.). Fire Department Response Times Vs Flashover. *Fire Engineering*, 113, 114.

Watts, John. M, Jr., Ph.D. (1991, Feb.) Axioms of Fire Risk. *Fire Technology*, 1.

APPENDIX A

ELEMENTS OF ANALYSIS

To describe each element of the fire response analysis, an inclusion of quoted comments by authors of resources reviewed in the research process is utilized. The purpose is to point out the many specific components that the authors had utilized in concluding the elements that should be part of a fire suppression ability analysis in comparison to the fire risks and hazards within a community. Those completing an analysis process should give thought to all the comments to provide an understanding of what should be considered in the usage of each element.

Distribution, the provision of adequate service within a specific boundary limited area.

“Distribution: station locations needed to assure response deployment to minimize and terminate emergencies. ... measured by the percentage of jurisdiction covered by 1st due within adopted public policy response times. ... policies shall include benchmarks for interventions (IAFC, 1995, p.6-4).”

“The distribution of fire stations throughout a community plays an essential role in determining the level of fire and EMS protection provided (Reaume, 1998, p. 12).”

“The locations of fire stations usually revolve around the distance and response time to developed areas, neighborhoods, and target hazards. Response time is paramount to fire station location and decisions concerning additional fire stations (Reaume, 1998, p. 13).”

“Based upon a desire to control fires offensively before they become large and to make provisions to rescue trapped person, a quick initial attack, backed up by a concentrated force, is required. This strategy dictates a well planned fire station location and distribution system (IAFC, 1995, p. 6-26).”

It should be noted in a recent study by Waters (February, 1999), that the determination of an appropriate response time should not be based on an attempt to arrive and apply water to a fire prior to flashover - as has been utilized in the past. ...

“What would it take for the fire department to respond in such a manner as to be able to apply extinguishing agent on the burning material prior to the point at which the fire becomes deadly? I came to the conclusion that it would be nearly impossible for the fire department to achieve a goal of applying an extinguishing agent on a fire before flashover [justification for the conclusion is provided in the article]. Yet, when we compare our response times ... not including travel times, with the 3.3 minutes it takes for flashover, it becomes obvious that we need to reassess our approach to fire response (p.113, 114).”

“Once the time goal has been set ... the agency should evaluate whether its resources have been properly deployed within its jurisdiction boundaries to be able to achieve its own response time within a certain level of predictability (IAFC, 1995, p. 6-27).”

“Professionally trained and equipped personnel must arrive, be deployed, and attack the fire within specific time frames if specific fire ground strategies and tactical objectives are to be met. Given an offensive objective to control a fire before it has reached its maximum intensity requires a rapid deployment, a concentration of resources, and an adequate water supply (IAFC, 1995, p. 6-27)”.

Initial Attack Capability, the ability to quickly position the required resources to establish an effective fire attack at the fire.

“Objective: initiate actions to handle imminent life threatening conditions ... establish the following fire ground positions - primary interior attack within 10 minutes of the receipt of alarm by fire department:

- Establish Incident Command
- Establish water supply
- Establish and maintain two hoselines (300 gpm attack)
- Provide support personnel for each attack line
- Provide victim search and rescue team
- Provide ventilation team
- Provide rapid intervention team (NFPA, 1998, p. 10)”

“The minimum fire force recommended for any community is necessarily dependent upon the expectations of the community and the members of the mobile fire force.

... It does seem reasonable to say that not less than two fire suppression vehicles and command officer should respond to any structure fire and that the number of personnel responding should be sufficient to carry out the task ...

41 of the fire departments making up a portion of the Metropolitan Chiefs section of the International Association of Fire Chiefs, no department in 1995 dispatched fewer than thirteen firefighters (including a command officer) to a reported fire in a single family detached dwelling. The average number dispatched was 18.6 (Granito, 1997, p. 10-33).”

“A rule of thumb is to provide one company for each 250 gpm that may be needed in an interior attack, plus personnel for rescue and other operations that need to be performed simultaneously with the advancing of hose lines (Granito, 1997, p. 10-35).”

“According to the National Fire Academy (NFA) course *Fire Risk Analysis*, a fire department must generate its required initial attack [water] flow within 10 minutes (Carter, September 1996, p. 72).”

Concentration, the ability to increase the response effort to meet the fire attack demands beyond the initial attack within a timely period

“Concentration implies that there are certain risks that will require resources beyond that available on initial attack. The self evaluation phase of standards of coverage should include an analysis of whether or not sufficient resources are available within secondary or tertiary time

frames to amass and concentrate staffing and equipment to deal with risk levels that demand extraordinary effort. This is best defined by describing the types and numbers of total resources that can be committed to deal with specific risks (IAFC, 1995, p. 6-28)."

"Based upon a desire to control fires offensively before they become large and to make provisions to rescue trapped persons, a quick initial attack, backed up by a concentrated force, is required (IAFC, 1995, p. 6-26)."

"Where fire frequency is such that any fire company may expect two or three working fire per day, or where structures to be protected require a heavy initial response, closer geographical spacing of or increased personnel assigned to individual fire companies may be necessary (Granito, 1997, p. 10-37)

"At large structure fires, additional fire fighting personnel are needed to cover the various points of fire attack. ... the arduous the expectations placed on the mobile fire suppression crew, the greater the required resources. ... the more extensive the concentrated fire potential, the greater the required fire suppression resources (Granito, 1997, p. 10-34)."

Effectiveness, a system wide measure of the performance or productivity of the fire suppression services provided.

"As the plan is implemented, the process must include the establishment of a *feedback loop*, providing a continuing assessment of how well the plan is contributing to successful completion of goals and objectives, and feeding revised data back into the plan so continuing redesign occurs (Granito, 1997, p. 10-39)."

"Likewise, the fact that most fires are suppressed with minimum losses and injuries, does not indicate conclusively that an adequate level of fire department service has been provided. ... It is imperative that fire department management maintain reasonable standards based upon local and national fire loss experience. Fire department management is responsible for maintaining highly trained efficient operational units to perform assigned tasks in both the prevention and suppression of fires (Paulsgrove, 1997, p. 10-21)."

"It is not difficult to record the number of inspections or the number of alarms that constitute the work load for a given period. Such measures do not, however, contain the sense of quality or goal achievement that relate to effectiveness and productivity. ... In addition, productivity measures typically include total system costs such as dollars lost owing to fires, insurance premiums paid, and money spent for private alarms systems - cost which are not among the data items collected by a typical fire protection service in a community. Furthermore, the important measures include fires prevented, rescues and saves made, and fire contained in terms of spread. These quantities are difficult if not impossible to define, and the information must often be inferred from actual data rather than directly measured (Greene, 1979, p. 362)."

“Three ways to use measures of productivity [effectiveness] are as follows:

1. To compare productivity measures among many communities
2. To compare these measures within a single community over time
3. To develop optimal performance specifications and then to measure current performance against these optimal measures (Greene, 1979, p. 366).”

“Comparing a community to others is undertaken to find out whether a community performs better, equally well, or worse than similar communities. There are major limitations in this approach which may lead to the erroneous conclusion that one community has a more productive fire protection service than a second. ... However, in spite of these limitations, it can be helpful (but, of course, not conclusive) to compare performance against similar classes of communities (Greene, 1979, p. 366).”

“The second type of comparison involves comparing a community’s productivity measurements against measurements made at earlier times in the same community. Long term comparisons of performance, for example, over a five year period, raise difficulties in interpreting measures as a result of changing community characteristics. Whether the increase or decrease in the productivity of the fire protection service is significant or insignificant requires the interpretation of informed fire service managers. Nevertheless, it is important to be able to assess year-to-year changes (Greene, 1979, p. 367).”

“The third type of comparison is the most challenging and the most difficult to undertake. It begins with a specification of optimal (that is, the very best) performance and then compares prevailing practices with that optimum.

In order to develop a specification of optimal performance, it is necessary to first develop a model (usually mathematical model or a simulation model) of the physical phenomena and their relationships for the fire service.

The work done in this area has focused on fire station location, deployment of fire vehicles, manning patterns and work schedules and the effectiveness of fire prevention inspections.

A rather interesting aspect of this work, which separates it from other measures of productivity, is that it is constructive - that is, it points the way to increasing productivity. The other comparative approaches merely indicate where a community stands with respect to similar communities (Greene, 1979, p. 367)

Efficiency, a system wide measure of the ability to provide the desired results at an acceptable cost

“[Efficiency] Is the system wide measure of the cost efficiency of the resource allocation plan. Efficiency is typically measured for each resource in the system as it contributes to the whole. The goal is to the geographical extent possible, level the area covered and workloads of the companies in the initial effective response force. In an ideal system, each resource would cover an equal share of the workload (IAFC, 1995, p. 6-28).”

“The term efficiency pertains to the relationship between inputs and transformations. ... Efficiency measures, however, are not generally very useful in the fire service because they do not relate to the outputs or final products of the system (Greene, 1979, p. 361).”

“One of the reasons why efficiency has been a more popular concept than productivity (effectiveness) is that outputs in the public sector are often poorly defined and as a result difficult to measure. ...

Systems can be further characterized as having inputs and outputs. The inputs are the resources supplied to the system, while the outputs are the final product resulting from the methods of *transforming* these resources to meet needs (economists would say demands) from the environment. ...

To be specific, the *inputs* into the fire protection service are the short term (that is, annual) dollar amounts that are then transformed into salaries, debt service, materials and tools, vehicle maintenance, and other items. Other inputs are of a longer term or capital nature, including vehicle purchase expenditures and money spent for fire house construction or rehabilitation. ... The *outputs* are represented by the confinement of damage and fire spread, the performance of rescues and saves, and the prevention of fires (Greene, 1979, p. 361).”

Response Reliability, a measure of the likelihood that the appropriate response resource will be available to respond to a fire alarm

“Response reliability is defined as the probability that the required amount of staffing and apparatus will be available when a fire or emergency call is received. ...

As the number of emergency calls per day increases, the probability increases that a needed piece of apparatus will already be busy when a call is received. Consequently, the department's response reliability decreases (IAFC, 1975, p. 6-29).”

“Consideration must be given also to maintaining an adequate concentration of additional forces to handle multiple alarms at the same time, while still providing minimum fire protection coverage for the other areas under the fire department protection (Granito, 1997, p. 10-34).”

“Response Reliability is defined as the probability that the required amount of manpower and apparatus will be available when a fire call is received. If every piece of fire department apparatus were available every time a fire call was received, then the department's response reliability would be 100%.

If, however, a call is received for a particular company but that company is busy at another call, a substitute company must be assigned from another station (Coughlin, 1991, p. 9).”

“Also known as unavailability, ... More refined, unavailability measures indicate not only how often the first-due company to a particular location will be unavailable, but also how often both the first-due and second-due companies will be unavailable. Unavailability measures permit calculations of better estimates of coverage than the average travel time to all locations in the city (Walker, 1979, p. 73)

“Where the fire frequency is such that any fire company may expect two or three working fires per day, or where structures to be protected require a heavy initial response, closer geographic spacing of or increased personnel assigned to individual fire companies may be necessary (Granito, 1997, p. 10-35)”

“The first is to study congestion, called queuing, in which the delays that occur while individuals are waiting for service are related to the number and types of servers. ... Queuing studies are useful for determining the number of fire companies to have, the number and location of alarms boxes they should cover, the best patterns for redeploying fire companies after a large fire depletes coverage in an area, and similar issues (Greene, 1979, p. 382).”

“Queuing theory provides methods to analyze whether waiting lines will occur [additional calls for service] and what the consequences of waiting lines will be (US Fire Administration, 1995, p. 141).”

“By applying queuing theory, we can estimate several other system performance measures. Three of the most common are:

1. The probability that a person calling for service will have to wait
2. The average number of citizens waiting for service
3. The average waiting times for those citizens (US Fire Administration, 1995, p. 144).”

Drawdown, a limit to the amount of resources that will be allow to leave the primary area of response to aid other response areas or agencies

“Mutual aid or mutual response should not be relied upon for routine emergencies, since there may be times when local communities may preclude the anticipated assistance (Granito, 1997, p. 10-34).”

“Mutual aid plays an important role in providing additional resources. Almost all jurisdictions rely to some extent on mutual aid from surrounding areas to provide fire-fighting resources on a routine or major emergency basis (Paulsgrove, 1997, p. 10-23).”

Resource Exhaustion, the absolute limit of resources available to respond for both initial response and area-wide response

“Resource exhaustion occurs when a system is out of resources for both initial response and an area-wide effective response force. In a small jurisdiction, this would mean all units are committed. In a large jurisdiction, it might be one sub-area (battalion or division) at total commitment. ... When analyzing how to handle resource exhaustion, queuing measurement of frequency, availability of mutual aid and the call-back of personnel all must be considered together (IAFC, 1995, p. 6-30).”

“It is frequently impossible for small cities to fully staff all of the fire companies they need to handle working fires throughout the community. In many cases, the population density and the values

protected per square mile are relatively low. Such low levels of staffing should be backed up promptly to ensure adequate personnel by off-shift or call personnel or by multiple-alarm response (Paulsgrove, 1997, p. 10-23)."

"Personnel requirements should be based on the total strength of first-alarm assignments, not individual company strength (International Fire Service Training Association, 1984, p. 58)."

Historical Response Data, a means of comparing the effectivity and efficiency of the fire service provider with previous performance of itself or other comparable communities or agencies

"First, if by map measurement a department expects to cover an area with a five minute travel time; does it? ... Second, for a given multi-company area, or city-wide measure, are concentration cost efficient? ... Third, is the critical task analysis holding up? Maybe distribution and concentration are good, but an area has really built-up and the fire flow dictate increasing company staffing to get all tasks done in a timely manner (IAFC, 1995, p. 6-31)."

"Good data are essential to managing a modern fire department of any size. Today, when management science is used more and more by police and other public services, and when tight budgets sometimes dictate layoffs and the outright closing of fire stations, adequate data to explain the fire department's needs and successes are essential if a fair share of attention and resources is to be obtained for fire protection (Schaenman, 1979, p. 455)."

"For suppression, the data system can show how well the loss per fire is being held down. The data system also can provide information on response times to emergency calls in various areas of the community; frequency of fire; manning levels used at various types of fires; times of day, week, and year of most fires; and similar areas. This information can help guide policies on whether more stations are needed or whether existing ones should be relocated; the desirability of variable versus constant manning levels; and the need for new types of apparatus (Schaenman, 1979, p. 473)."

"Strategic planning is the process by which management allocates long-range resources, such as fire stations, fire-fighting equipment, and fire fighters. Some fire departments have developed sophisticated models for this purpose, while others have contracted for the models and services of outside resource groups. Most fire departments, however, depend upon the statistical information from fire incidents and emergency reporting systems (Harvey, 1997, p. 10-45)."

Acceptable Levels of Risk, the level of fire risk that a community is willing to accept

"No matter how one defines the term "acceptable level of fire risk, it will be dependent on the problem context and on the individual judging acceptability, ie. on the alternatives and objectives. Individuals and organizations are inconsistent in their risk aversions. ... One contention is that the

present public fire risk situation must be acceptable since otherwise there would be greater concern and calls for action. While this may hold for the agglomeration of all public fire risk, it is not so for specific cases that are repeatedly seen to be under-or-over protected (Watts, 1991, p. 1)."

"The prudent level of risk is obtained by setting goals and objectives on the one hand and limitations criteria on the other; for example, a goal to eliminate all deaths due to fire would be

clearly technically, economically, and socially infeasible because we would not be able to pay for all the protection. ... Risk management, in summary, identifies the problem and sets a level of service which is affordable; in so doing, it sets level of risk which is acceptable, devises means to control the losses to the acceptable level, and continually monitors the results and changes the means as necessary (Steen, 1979, p. 149)."

"Fire, both as a threat and reality, has its costs, including deaths, injuries, property losses, hospital bills, and lost tax revenues, plus the cost of maintaining fire departments, paying for insurance premiums, and providing built-in fire protection. Each community must decide upon an appropriate level of investment in fire protection. Some costs that are beyond the public's willingness to bear may be transferred to the private sector (as when buildings over a certain size or height or with a certain occupancy are required to have automatic extinguishing systems) (Granito, 1997, p. 10-40)."

"Unprotected risk is the degree of imbalance that exists when a given level of potential demand is at a certain level and the organization capacity to meet that demand is not of sufficient capacity to cope (Coleman, 1999, p. 14)."

"Even more basic to the concept of adequate fire safety is the recognition that fire protection is both a public and a private concern. Adequate fire protection therefore is a unique combination of private property protection reinforced by an emergency service delivery system. Furthermore, and possibly most important, there is the realization from careful investigation that private property may be carrying an unrecognized high risk if the concept of adequate fire protection relates solely to the level of fire suppression force, to the response time of those forces to a given emergency, and to the capability of those forces to conserve property after they arrive. The analysis may reveal that the private sector has expectations from the suppression forces that are not realistic. In other words, there are limits to the capability of fire suppression forces to save lives and property. This capability needs to be defined in each community. ...

The final plan should reflect a quality of community or regional fire safety base on both professional and citizen expectations; it should clearly define the level of risk the community or region is willing to bear; it should clearly document the costs associated with the planned level of service; and it should plot a future course of action to either achieve or maintain prescribed levels of community or regional safety over at least a ten year period. Above all, the master planning process should identify both the capability and the limitations of the public fire service delivery system (Hickey, 1979, p. 65)."

Demographic, Geographic, and Environmental Conditions, local conditions pertaining to the specific community that will impact fire suppression responses

“Several findings emerge from this literature review. First, fire rates are affected by community characteristics. Little correlation between fire loss and the resources in a fire department has been found. Rather, findings point to each community’s socioeconomic and environmental factor as the primary determinants of fire loss, with fire departments as a secondary influence. ...

Without an understanding of the causes of fires and the various contributions of the social, behavioral, environmental, and economic realms, specifying the most affective policies to reduce the fire problem is nearly impossible. A theory would also be helpful in allocating resources between fire suppression and fire prevention (Jennings, 1999, p. 27).”

“Wallace and Wallace (as cited in Jennings, 1999) posit that fire incidence is heightened by overcrowding and substandard housing. When reductions in the number of fire companies were made in the 1970’s in New York, they assert, fire became severe, leading to heightened damage and large-scale displacement as buildings became inhabitable. This situation forced former residents to “double-up” with family or friends in adjacent areas. This doubling-up, in turn, overloaded the building infrastructure and led to an even higher rate of fires (p. 11).”

“Chandler (as cited in Jennings, 1999) et al. went on to consider studies of London and two other urban areas in England and found that fire rates were generally correlated with age of housing and socioeconomic status (p. 12). ... Chandler et al. found that three social variables were highly correlated with fire rate: home ownership, socioeconomic group, and employment status (p. 12).”

“An analysis of rural fire deaths by Gunther (as cited in Jennings, 1999) found that climate was a significant factor in fire death rates (p. 13).”

“Like other systems, the fire protection system operates in an environment which contains factors that affect the operation of the fire service but are largely not under the control of the fire service. This environment includes the weather, housing and construction practices, the socioeconomic makeup of the community and its surrounding area, density, streets and traffic patterns and many other factors (Greene, 1979, p. 360).”

“In evaluating the adequacy of fire protection in any given area, major considerations must be given to the ability of the fire department to handle efficiently any reasonably anticipated workload. This requires an evaluation of the possibility of simultaneous working fires and other emergencies; weather factors that may contribute to the spread of fire, the delay of response, or the possibility of slow operations at the scene; and other demographic or geographic conditions that might affect the frequency, severity, and spread of fire occurrence and the response time of initial fire-fighting units (Granito, 1997, p. 10-35).”